the Rhynchophora manifested by the transfer of a function from the posterior to the anterior part of the body, and the linear extension of the latter, in accordance with this "change of base."

The principles of classification of Rhynchophora, and their division into families, will be discussed in a subsequent memoir. It is, however, proper to observe that the peculiar construction of prothorax above described as characteristic of the Rhynchophora is not exhibited in the Bruchidæ, which family, as observed by Lacordaire (Gen. Col. vii. 600) should be viewed as closely related to, if not actually a portion of, the great family Chrysomelidæ.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 20, 1867.—Lieut.-General Sabine, President, in the Chair.

"On some Elementary Principles in Animal Mechanics." By the Rev. Samuel Haughton, M.D., Fellow of Trinity College, Dublin.

There are some elementary principles in animal mechanics which are so natural that they may be assumed as probable, and as such, have not received from observers the attention they really deserve.

Among these principles I select for illustration the two following:—

i. *The force of a muscle is proportional to the area of its cross section.*

ii. *The force of a muscle is proportional to the cross section of the tendon that conveys its influence to a distant point.*

i. In order to test the first of these statements, I made a careful examination of the cross sections of the muscles that bend the forearm and leg, in a very finely developed male subject, with the following results:—

Neglecting the slight effect of the *supinator radii longus* in flexing the forearm, I found the cross sections of the *biceps humeri* and *brachiæus* to be as follows:—

	Cross section.
1. *Biceps humeri*	1·914 sq. in.
2. *Brachiæus*	1·276 „
	3·190

The cross sections of the muscles that bend the leg were found to be in the same subject:—

1. *Biceps femoris* (long head)	. . .	2·59 sq. in.
„ (short head)	. . .	1·14 „
2. *Semitendinosus*	. . . .	1·87 „
3. *Semimembranosus*	. . . .	2·25 „
4. *Gracilis*	. . . .	0·89 „
5. *Sartorius*	. . . .	0·59 „
		9·33

When the arm was held vertically, and the forearm horizontally with the fist shut and in supination, I found that 39 lbs. was the limit of the weight that could be lifted when suspended at $12\frac{1}{4}$ inches from the axis of the elbow-joint, and that the perpendiculars let fall upon the directions of the muscles from the same axis were:—

1. *Biceps humeri*	. . . . . .	2·06 inches.
2. *Brachiæus*	. . . .	1·07 „

Hence if K denote the force of the muscle, per square inch of cross section, we have, adding 2 lbs. for the weight of the forearm at $12\frac{1}{4}$ inches from the axis of the joint,

$$41 \text{ lbs.} \times 12\tfrac{1}{4} \text{ inches} = K \times \left\{ \begin{array}{c} 1·91 \times 2·06 \\ +1·28 \times 1·07 \end{array} \right\}$$

$$502\tfrac{1}{4} = K \times \left\{ \begin{array}{c} 3·935 \\ +1·369 \end{array} \right\}$$

$$= K \times 5·304$$

and finally $K = 94·7 \text{ lbs.}$

This represents the force per square inch of cross section that the muscles flexing the forearm are capable of exerting.

In order to measure the force of the muscles flexing the leg, I placed the observer lying upon his face upon a table, with the legs extended over its edge, and having fastened down the thighs, I observed the maximum weights, suspended from the heel that could be conveniently lifted, and found that 34 lbs. was the limit; to this must be added 3 lbs. for the weight of the leg, supposed suspended at the heel, which was measured as $16\frac{1}{2}$ inches from the axis of rotation of the knee-joint. The perpendiculars let fall upon the directions of the several muscles flexing the leg were then measured:—

		Perpendicular.
1. *Biceps femoris* (long head)	. . . .	0·95 in.
„ (short head)	. . . .	0·56 „
2. *Semitendinosus*	. . . .	0·40 „
3. *Semimembranosus*	. . . .	0·65 „
4. *Gracilis*	. . . .	0·25 „
5. *Sartorius*	. . . .	0·00 „

Hence we find, for the determination of K (the coefficient of muscular contraction per square inch of cross section),

$$37 \times 16\tfrac{1}{2} = \mathrm{K} \times \begin{cases} 0{\cdot}95 \times 2{\cdot}59 \\ +0{\cdot}56 \times 1{\cdot}14 \\ +0{\cdot}40 \times 1{\cdot}87 \\ +0{\cdot}65 \times 2{\cdot}25 \\ +0{\cdot}25 \times 0{\cdot}89 \\ +0{\cdot}00 \times 0{\cdot}59 \end{cases}$$

or,

$$610{\cdot}5 = \mathrm{K} \times \begin{cases} 2{\cdot}460 \\ +0{\cdot}638 \\ +0{\cdot}748 \\ +1{\cdot}462 \\ +0{\cdot}222 \\ +0{\cdot}000 \end{cases} \qquad \overline{5{\cdot}530}$$

and, finally,

$$\mathrm{K} = \frac{610{\cdot}5}{5{\cdot}53} = 110{\cdot}4 \text{ lbs.}$$

It appears from the foregoing considerations that the force of contraction of the muscles, per square inch, is in

The arm	94·7 lbs.
The leg	110·4 „

These numbers are, perhaps, as near to each other as this class of observations admits of; but I believe that they do not differ so much really as they appear to do, for the following reason:—

As it was not convenient to procure a good subject destroyed by a violent death, I made use of a powerful man who had died of cholera * and who had been a blacksmith by profession. Now it is natural to suppose that the muscles of the arm of a blacksmith are more developed than those of his leg; so that their cross section would be relatively too great, and the coefficient derived from that cross section, therefore, too small. I therefore compared the sections of the *biceps humeri* and *brachiæus*, found by me, with the only other measurements with which I am acquainted, for the knowledge of which I am indebted to Dr. W. Moore of Dublin, who translated the results for me, from the Dutch, of Messrs. Donders and Mansfelt † of Utrecht.

Cross Sections of *Biceps humeri* and *Brachiæus*.

	millims.	sq. in.
1. *Biceps humeri* (long head)	530	0·821
„ „ (short head)	452	0·701
2. *Brachiæus*	614	0·952
	1596	2·474

* It is well known that after death by *cholera*, life continues in the muscles, and manifests itself for some hours by movements, and by the existence of the muscular *susurrus*. This latter fact, the first notice of which belongs to Dr. Collongues, of Paris, I have repeatedly verified, as also the continuance of the *susurrus* in cases of death by *tetanus*. It appeared to me, therefore, that such a subject as I selected was one well suited to the purpose of my observations.

† Over de Elasticiteit der Spieren. Utrecht, 1863.

If this estimate of the cross section of the muscles be assumed instead of my own, the coefficient found by me should be increased in the proportion of 3190 to 2474; or

Coefficient of muscles of forearm . . $94{\cdot}7\times\frac{3190}{2474}=122$ lbs.

The mean of the coefficients found from my own measurement of the muscles of the arm, and that of Professor Donders, is 108·4 lbs., which agrees nearly with that obtained from the muscles of the leg, viz. 110·4 lbs., and the mean of all the observations on arm and leg would be **109·4 lbs.,** a result which I consider to be not far from the truth.

The cross sections of the muscles were found by cutting them across with a sharp scalpel, and marking out their section on cardboard, and afterwards weighing the marked portions, the weights of which were then compared with the weight of a known number of square inches of the same cardboard, and so the cross sections in square inches calculated.

I give here, for the purpose of illustration, the actual sections of the muscles of the leg. (Figs. 1–6.)

The perpendiculars let fall upon the directions of the muscles were measured by stretching strings from the origin to the insertion of the muscles, and measuring, by means of a compass, the perpendiculars let fall upon these strings from the axis of the joint.

The weights of the muscles themselves were as follows:—

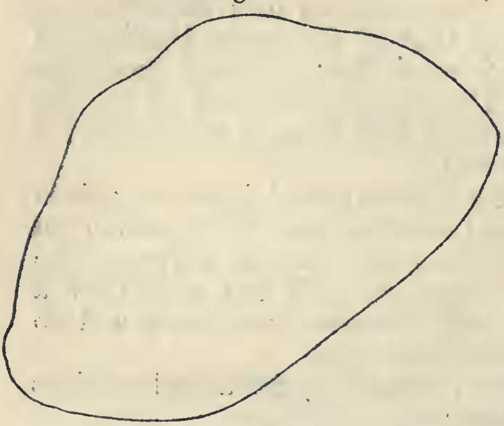
	oz.		oz.
1. *Biceps humeri* . .	4·22	5. *Semimembranosus* .	7·25
2. *Brachiæus*	5·04	6. *Gracilis*	2·98
3. *Biceps femoris* . .	10·74	7. *Sartorius*	5·66
4. *Semitendinosus* . .	5·17		

ii. The principle of economy of force or of material in nature would lead necessarily to the principle that each tendon conveying the effect of a force to a distant point should have the exact strength required, and neither more nor less; for, according to the doctrine of *final causes*, it was originally contrived by a perfect architect, and according to Lamarckian views it must have perfectly accommodated itself to the uses to which it is applied. According, therefore, to either view, if the tendon be too strong, it will become *atrophied* down to the proper limit; and if too weak, it must either break or be nourished up to the requisite degree of strength. It seemed to me desirable to prove this fundamental proposition in animal mechanics by direct observation; and I selected for this purpose the tendons in the leg of several of the large running birds (*Struthionidæ*),—and always with the same result, viz. that *the cross sections of any two muscles tending to produce a similar effect are directly proportional to the cross sections of their tendons.*

I shall select as an example the case of the *flexor hallucis longus* and *flexor digitorum communis perforans* of the Rhea, whose tendons unite into a common tendon halfway down the posterior side of the *canneon* bone of the bird.

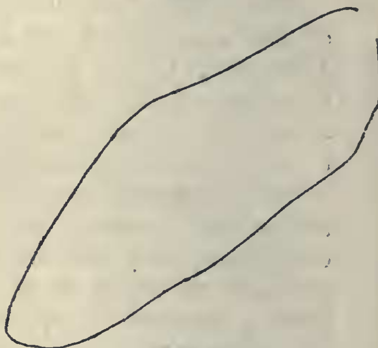
The cross sections of these two muscles are shown in the annexed figures, taken as in the human subject (figs. 7 and 8).

Fig. 1.



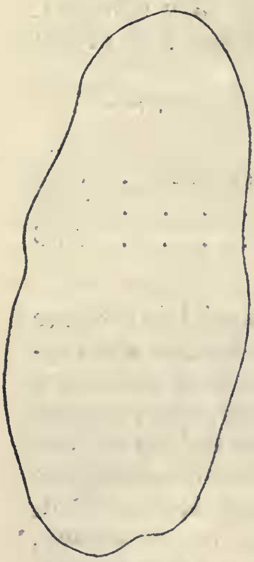
Biceps (long head).

Fig. 2.



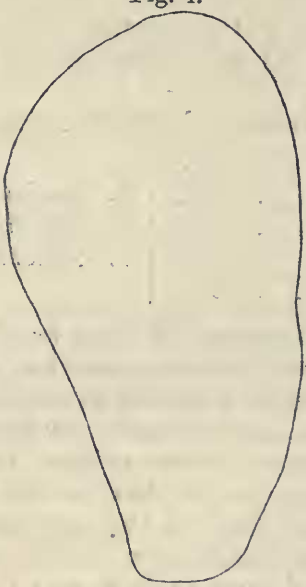
Biceps (short head).

Fig. 3.



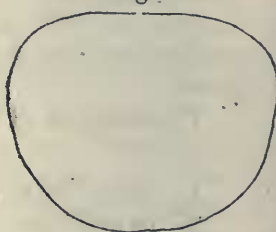
Semitendinosus.

Fig. 4.



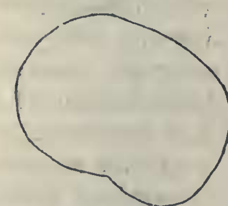
Semimembranosus.

Fig. 7.



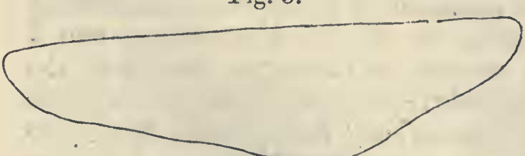
Flexor perforans. (Rhea.)

Fig. 8.



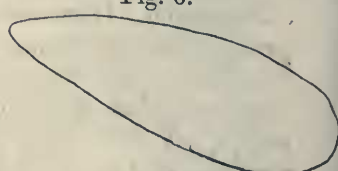
Flexor hallucis. (Rhea.)

Fig. 5.



Gracilis.

Fig. 6.



Sartorius.

The areas of these cross sections were found to be as 245 to 160; or the less was 65 per cent. of the greater.

Two equal lengths of the dried tendons were then weighed and found to be in the proportion of 845 to 495, which was assumed to be the proportion of their cross sections. The smaller of these numbers is 59 per cent. of the greater—a result that seems to be as near to the former result derived from the muscles as can be expected in this class of experiments.

"On the Anatomy of *Balænoptera rostrata,* Fab." By ALEXANDER CARTE, M.A., M.D., &c., and ALEXANDER MACALISTER, M.D. &c.

In this paper the authors give an account of the dissection of a young female of the Lesser Fin or Piked Whale, which was captured off Clougher Head, co. Louth, Ireland, on the 8th of May 1863.

After describing its external form, and giving accurate measurements of its various parts, the authors point out some differences between the relative sizes and positions of the organs of the animal as contrasted with similar parts of those of the same species which have been recorded by previous writers, especially as regards the position of the dorsal fin, which appendage seems to vary in situation in different individuals, and show that consequently no value, as indicative of species, ought to be attached to its relative position.

This is followed by a description of the osteology of the animal; and attention is drawn to the fact that the body of the axis vertebra is composed, in part, by the displaced body of the atlas, showing that what at present forms the upper half of the centrum of the axis is in reality the centrum of the atlas.

The myology of the different regions of the animal has been closely investigated, especially the rudimentary muscles of the paddle, which latter the authors have minutely examined.

The anatomy of the mouth, pharynx, and blowholes is described, and the mechanism by which the functions of respiration and deglutition are performed. In connexion with the larynx, a remarkable muscular pouch is mentioned as existing, which appendage is supposed by the authors to be accessory to the act of expiration, serving a somewhat similar office to that of the air-reservoir in a double-action bellows. Directly in front of the glottis there existed a peculiar hood-like fold of mucous membrane arranged in such a way as to allow of its being drawn over the orifice, and so prevent the entrance of all foreign substances into the respiratory tract during the act of deglutition.

The tongue was found fixed, as far as its tip, by a thick frænum. The lateral walls of the submaxillary cavity were thrown into folds, thereby admitting of considerable distention, this arrangement being peculiarly adapted to the feeding-requirements of the animal. The number of baleen plates found in the specimen was 280 on each side.

The muscles for acting on the blowholes were arranged in three strata, the superficial and deepest layers being used in opening, and the intermediate one for closing the nasal canals.

The anatomy of the eye and ear is fully described in the original paper, together with that of the digestive, nervous, and vascular systems; in connexion with this last, remarkable vascular retia were found, situated in the axillary, submaxillary, and cervical regions.

MISCELLANEOUS.

Notice of a new Species of Spider Monkey (Ateles Bartlettii) *in the British Museum.* By Dr. J. E. Gray.

Mr. Edward Bartlett, who is collecting specimens on the banks of the Amazons, has sent home a new and beautiful species of spider monkey, which I propose to call *Ateles Bartlettii,* in honour of the father and sons. Every one acquainted with the father knows him as a most careful and accurate observer and most obliging person; and I believe his sons are following in his footsteps.

Ateles Bartlettii may be thus distinguished:—

Fur abundant, long, and soft. Black; the cheeks white, a band across the forehead over the orbits bright reddish yellow; the chest, belly, inner side and front and back of the limbs, and the sides and under surface of the tail yellow.

Hab. Brazil, the upper part of the Amazons (Bartlett). In Brit. Mus.

Note on a Species of Planarian Worm hitherto apparently not described. By the Rev. W. Houghton, M.A., F.L.S.

To the Editors of the Annals of Natural History.

Gentlemen,—I have recently met with a form of Planarian worm which I am unable to identify with any described species, either in Diesing's 'Systema Helminthum' or in Johnston's 'Catalogue of non-parasitic Worms in the British Museum.' It belongs to the family of Dalyellidæ, and is a species of the genus *Typhloplana,* Hemp. & Ehrenb. Diesing (Syst. Helminth. vol. i. p. 231) enumerates four freshwater species of this genus; and Dr. Johnston admits two into the British fauna, viz. *T. fœcunda* and *T. prasina,* the first of which is white, the second of a beautiful grass-green colour. My specimens are almost entirely black, except at the margins near the head. I find them within the stems of *Sparganium* in a weedy reedy pond where other Planariæ (such as *Polycelis nigra* and *P. brunnea, Planaria lactea* and *P. torva*) are common. The species, which I believe to be new, occurs sparingly. Diesing's definition of the genus is as follows:—

"*Corpus* oblongum, teretiusculum. *Caput* corpori continuum. Os centrale v. subcentrale. *Ocelli* nulli. *Aperturæ* genitales.... Aquarum dulcium, rarissime maris incolæ."

The species, which I propose to call *Typhloplana nigra,* may be thus described:—

Body rounded anteriorly, tapering to a point behind; colour deep